Project-Based Learning and Student-Designed Extra Credit in a High School Science Classroom

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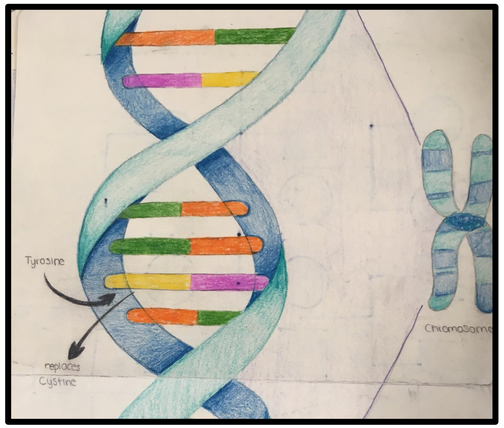
Abstract

Using inquiry and PBL to create an engaging classroom environment that fosters higher-order critical thinking skills and promotes student agency in problem solving encourages students to delve more deeply into content than is sometimes possible to accommodate when simultaneously trying to accomplish a semester's-worth of standards for an AP or MCAS class. Rather than truncating or glossing over answers to student questions that are larger or beyond the scope of a standardized tests in the interest of time, implementing a system by which inquisitive students can take their learning to the level they deserve within the confines of a semester and share their acquired knowledge with the rest of the class increases overall understanding of a subject, builds leadership skills, fosters self-confidence, and encourages a curious and innovative classroom climate.



Student-Designed Projects 2018-2019

Research: *"Convergent Evolution: Limblessness in Squamates"* (Fall, 2018: AP BIology)

Experiment: *"Effects of Color of Light on Photosynthesis of Peas"* (Spring, 2019: Honors Biology)

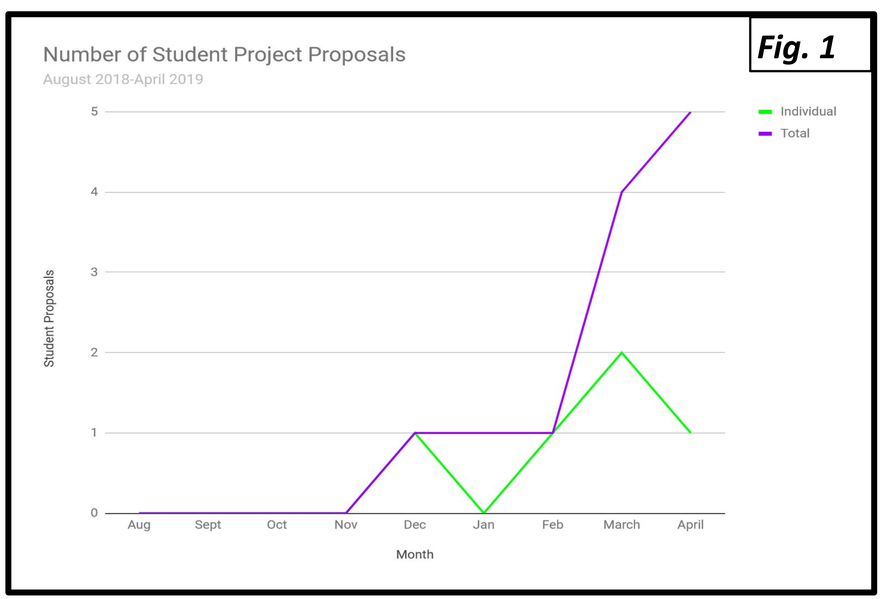
Logistics: *"Midterm Review: A Jeopardy Game!"* (Spring, 2019: Honors Biology)

Creative: *"Creating Technical Illustrations to be Used as Models"* (Spring, 2019: Biology)

Introduction

The literature separates project based learning from other forms of Inquiry in that it not only encompassess constructivist principles such as actively involving learners in context-specific learning activities, and achievement of problem-solving goals through social group interactions and knowledge sharing, but also incorporates elements of authenticity by allowing students to engage in real-world concept attainment practices to answer questions of their own design (Kokosaki et al., 2016). As the world students will enter after High School becomes increasingly more technological such that most of the facts in our textbooks can be websearched with relative accuracy on a moment's notice, there has been an evident shift in requirements for success as an adult away from recall and towards higher-order thinking skills that set individuals apart from the whole of smart phone and computer-owning individuals. Simultaneously and perhaps without coincidence, there has been a shift in educational standard. The new NGSS standards focus significantly more on modeling than on explanation. The new AP standards stress inquiry and experimental design. To an increasing extent, society is engaged in a push towards skills associated with independence, innovation, and agency. Incorporating self-designed projects requiring students to propose a question, design and carry out research, defend their conclusions, and self-assess for credit supports this shift.

Self-designed projects also accomplish goals associated with community building. Any projects completed within the course must be presented to the class,and must be defensibly beneficial to the "good of the whole" in terms of the course. If a project proposal is not identifiably beneficial to the class as a whole, students are given the opportunity to argue the purpose and importance of their projects in written form. This process builds exercises skills necessary in real-world experiences that are not limited to STEM fields, like job interviews, salary negotiations, and interpersonal exchanges associated with self-worth.



References

Kokosaki, D., Menzies, V., & Wiggins, A. (2016). Project Based Learning: A Review of the Literature. *Improving Schools, 19*(3), 267-277. doi:10.117

Sluijsmans, D., Moerkerke, G.., Merrienboer, J., & Dochy, F. (2001). Peer Assessment in Problem Based Learning. *Studies in Educational Evaluation,* (27), 153-173. Retrieved April 10, 2019, from http://sluijsmans.net/wp-content/uploads/2019/01/Sluijsmans-Peer-Assesment-in-Problem-Based-Learning-2001_9.pdf

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Conclusions

Giving students the opportunity to design their own projects for credit based on personal interest and individual strengths promotes universally applicable life-skills like independence, agency, self-confidence, organization and curiosity, as well as a deeper understanding of content. Many projects also necessitate ability to use technology for research, use evidence to defend claims made based on a study, or design and experiment, which college-bound students will find invaluable in their future academic careers. Showcasing projects in the classroom via presentation after completion allows presenters to take ownership of their work, while simultaneously inspiring future projects among those in the student audience. While more data is necessary to confirm a relationship, Fig. 1 suggests that students are more likely to propose projects once they have seen their peers successfully complete and independent study.

Future goals for this project include increasing authenticity of student projects by finding avenues and building networks by which student projects can extend beyond the boundaries of the classroom, into the larger school, local, or even national community. Secondly, development of peer-assessment systems like student surveys are underway, and will be tested in the next iteration of the project. Research suggests that by implementing peer-assessment into PBL, students build higher-order critical thinking skills through the process of evaluation (Sluijsmans et al., 2016). Furthermore, peer-assessment necessitates engagement from the whole class in each project creating a community learning environment.